Chapter 3

Designing and Planting Your Buffer

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People live along the waterfront for a variety of reasons: a view of the water, access to outdoor recreation, privacy, or the soothing sounds of a babbling brook or waves lapping against the shore. Whatever the reason, a vegetated buffer can be designed to meet the needs of the landowners and improve the use and look of the property.

In general, a mix of mature trees, shrubs and low-growing plants (grasses, wildflowers, ferns or ground cover) is the best composition to protect water quality and provide wildlife habitat. Vertical layers of vegetation above the ground mean that a maze of roots exists below the ground. The more complex and deep the root systems, the greater their capacity to capture dissolved nutrients and other pollutants as they travel in subsurface flow. A more detailed discussion of how vegetated buffers capture and filter pollutants can be found in Appendix A.

Maintain a Lawn Area

You can still maintain the lawn around your house for picnicking, lounging and family events. Maintain grass height at a lush 2-3 inches; this will encourage a deeper and denser root growth and help the grass resist drought and weeds.

Maintain Your View

Low-growing vegetation such as shrubs, grasses, wildflowers, ferns and ground cover add root depth without adding height. A few trees can be situated to frame the view of the water from vantage points on the property. Careful pruning will maintain these views as the trees mature.

Maintain Your Lake Access

A mowed pathway through the buffer can provide access to the water. A pathway that is curved or meandering, especially on steep slopes, will help prevent the trail from becoming eroded and becoming direct channel for stormwater runoff.

Add Privacy

Pines and spruces provide year-round screens for privacy. Deciduous trees provide nice seasonal changes: leaves provide shade in the summer, foliage provides color in the autumn, and bare branches allow solar rays to light and warm the house in the winter. A dense thicket of shrubs, especially a prickly species like raspberry bushes, will discourage trespassers.

Provide Wildlife Habitat

A complex mix of vegetation, coupled with the nearby presence of water, attracts a greater number and diversity of wildlife. Vegetated buffers can help to reconnect isolated populations of wild creatures that we have separated by creating open, developed areas. Maintaining healthy wildlife populations and gene pools is becoming more of a challenge as we continue to pave over or fragment wild places. Buffers provide the cover wildlife needs to travel between the remaining wild areas.

To attract wildlife, resist that tendency to tidy up a natural buffer. Wildlife habitat is more than trees and shrubs; it is dead snags (perches for hawks and owls, cavities for nesting), downed

logs (hollows for cover and dens, cover for burrowing animals), brush (cover and food) and leaf litter. Cavities within standing snags provide nesting places for bird species such as wood ducks, mergansers, owls, woodpeckers, nuthatches, and bluebirds, as well as homes for many mammal species such as fishers, porcupines, raccoons, squirrels and bats. Logs provide den sites for foxes, bears and several other mammals. Raspberry bushes provide you and your wild friends with a summer treat.

Stabilize the Bank

A mix of trees and shrubs planted along the edge of the bank will best anchor soils. A plant list compiled by the Connecticut River Joint Commissions (Appendix B) provides an assortment of native trees and rates their ability to stabilize eroding banks. Willows, for example, are excellent for stabilizing shorelines, and they can grow from cuttings taken from nearby trees. Do not, however, plant them near septic systems or sewer lines; their roots seek out water and will invade these areas, clogging leach fields and strangling pipes. If conditions allow, plant wetland vegetation such as cattails and sedges in the shallows of the water; these plants will deflect and absorb the shock of flows and wakes before they hit the bank.

Deter Nuisance Geese and Deer

In some locations within Massachusetts, Canada geese and white-tailed deer are considered pests. Planting buffers along the shoreline helps to restore the landscape back to a more natural condition and will deter Canada geese from visiting your lawn. Geese love succulent green grass, but will not travel through tall grasses or dense vegetation to get to it. This is especially true when parents have goslings that cannot yet fly. Geese are most comfortable in open areas that provide unobstructed views around them and easy access to the water, which is their safe haven from predators. Planting a mix of shrubs and trees, or even allowing grasses and ferns to grow tall, will act as a barrier between the water and your lawn. Removing waterfront lawn means removing a ready source of food, which ultimately helps to maintain goose populations at more natural levels.

In some areas within the state, white-tailed deer have become accustomed to living alongside humans and have come to find that ornamental shrubs and trees can be quite delectable. If this is the case in your area, landscape the property and design the buffer to include native plants that deer find less appealing. A list of "deer-resistant" native plants can be found in Appendix D. If the deer are persistent, try spraying plants with deer repellant, which can be found at many nurseries and garden centers.

Maintain Cooler Water Temperatures

Streamside shade

Trees will help shade the stream channel and maintain lower water temperatures. At a minimum, trees planted on the south and west banks shade the water from the warmest rays of the sun. The height of the trees should be equal to or exceed the stream width to provide almost full shading. To quickly establish a forest buffer in an open area, plant fast-growing "pioneer species" such as

poplars and gray birch along the bank. Planting a shrub layer along with the trees will provide some additional shading and support a larger mix of wildlife. Pioneer species often do not have the thick foliage that produces the truly cool shading offered by slower-growing species such as maples, oaks, pines and spruce. Therefore, planting a mix of such trees among and behind the shoreline pioneer trees will provide denser shade in the long term.

Lakeside shade

Planting native trees along the shoreline of a lake will help to maintain cooler temperatures along the water's edge through shading. Shallow waters along the shoreline are easily heated by the summer sun. Because the shallow waters are the most productive for wildlife, it is important to maintain cooler temperatures here. For a more detailed discussion of water temperature and wildlife, visit Appendix A.

Infiltration

In addition to providing shade, vegetated buffers enable infiltration. Water is cooled as it comes in contact with and moves through the soil. Enabling infiltration is especially important for runoff originating from unnaturally warm areas, such as roads, parking lots, roofs and patios. Although not as warm as that from hard surfaces, runoff from open lawns is also unnaturally warm and should be allowed to flow through a shaded buffer before reaching the water body.

What Can I Do If My Yard Is Small?

The shorelines of many lakes and ponds are heavily developed; residential lot sizes are often less than one acre, and houses are often located less than 100 feet from the water. So the ideal buffer of 100 feet in width is out of the question in these cases. If your property fits into this category, you might think that you do not have enough room for a worthwhile buffer.

Think again. Even a small buffer is better than no buffer at all. Even returning a 20 to 30 foot-wide strip of shoreline to a more natural state can filter some pollutants and provide a travel corridor or habitat for wildlife. Maintaining a turf lawn around your house is acceptable because grass encourages stormwater to flow in a sheet, which then allows your buffer to work better. See Example 2 in Chapter 2 to view a small buffer on a small house lot.

Where a continuous buffer along the shore is not possible, consider planting segments of a buffer. Plant vegetation on openly bare areas on the property. Observe runoff patterns on your property during a heavy rainstorm and note the problem areas. Strategically plant your buffer segments in the path of runoff, where it can do the most good. To determine the location where a buffer will do the most good, conduct a Rainy Day Survey, described at the end of this chapter.

7 Steps to Designing and Planting Your Buffer

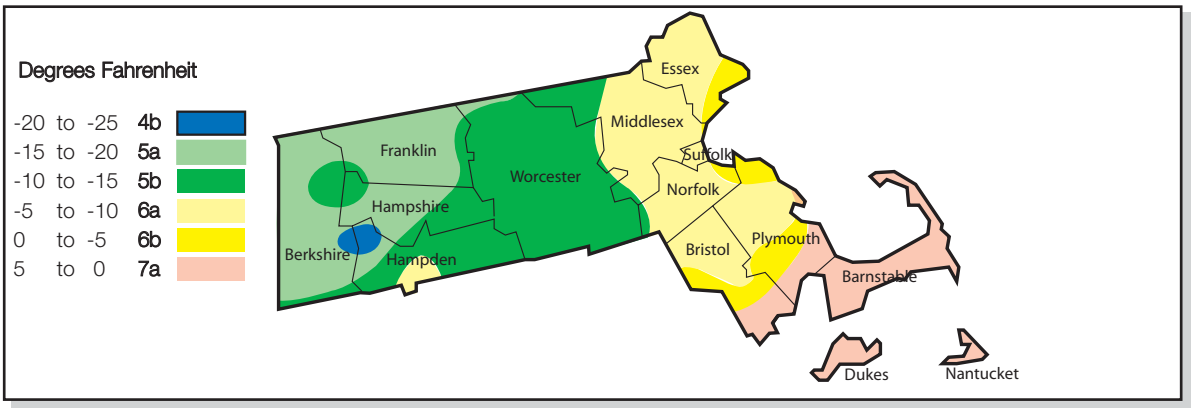
1. Envision New Landscaping Ideas

The first step in designing a buffer is to list the goals you have for your property. Draw a Site Map of your property in its current condition, noting the location of structures, driveways, walkways, beaches and other areas of activity, and trees and other vegetation. Then conduct a Rainy Day Survey, described at the end of this chapter, to identify runoff problem areas that a buffer may be able to correct. Use a second colored pencil to note problem areas on your map. Finally, sketch new ideas and goals onto your map, using a third colored pencil, to note the location and size of your buffer. Visit our sample Site Map in Chapter 5 for helpful ideas.

2. Evaluate Your Environment

You should then analyze your property's environment. Key factors that should be considered are soil type (deep, rich soil or shallow, poor soil; wet or dry soil; alkaline or acidic soil), sunlight level (full sun, partial sun, total shade) and hardiness zone. Also consider harsh winter winds that blow across your lake or pond. These winds can dry out the leaves or needles of evergreens (mountain laurel, pines, spruce) harming or even killing them. If possible, look at and identify the native plants that flourish in undeveloped areas around your property. These will be helpful indicators of what type of soil you are working with and what types of plants will succeed.

If you have questions regarding the condition of your soil, consider having it analyzed at your local Cooperative Extension Service. The cost of soil testing is minor in comparison to the overall costs of plants, soil amendments (if needed), and your labor. Home soil-test kits can also be used to determine soil conditions, although the results are not as reliable as those provided by the Cooperative Extension Service.



Hardiness zones in Massachusetts range from 4b to 7a. Please note that these are general and do not take into consideration site specifications such as soil type and daily sunlight levels. Southern exposures and sheltered areas may warm a site so that it is really a zone higher than the map indicates; likewise, northern exposures may make a site a zone lower.
Source: adapted from USDA.

Determine your general hardiness zone by referring to the map on page 3-4. The lower the number, the colder the conditions. Appendix B is an extensive list of native plants and includes the hardiness zones where the plants can be expected to succeed.

3. Layout Your Design

Delineate your buffer so you have a clear picture of its dimensions. If you have a planting plan, lay out your buffer according to its specifications. If you do not have a planting plan, this is your opportunity to determine how many plants are needed and where they should go. Delineate pathways or other areas that you want to remain open within your buffer, such as a picnic or sitting area. The edges can be marked with spray paint, flags, or stakes and twine.

4. Visit Your Conservation Commission

Once you have assessed your environmental conditions and have designed your buffer, you should approach your local Conservation Commission for guidance on how to comply with the Wetlands Protection Act (WPA). The Conservation Commission reviews projects in close proximity to water bodies to make sure that they comply with the WPA. Commission members can be a great source of information when you are designing your vegetative buffer. As well as helping you understand the wetland review and permit process, the Commission can also provide you with information on the various exemptions that, if your project qualifies, will allow you to perform the work without first receiving a permit from the Commission.

Most small-scale buffer plantings on residential property will require the filing of a Request for Determination of Applicability form (visit http://www.state.ma.us/dep/appkits/wpaform2.doc). This form helps you explain your project to the Conservation Commission. The planting of additional vegetation along water bodies is an environmental benefit, and in most cases the Commission will allow the work to continue as planned. To ensure that the work will not cause undue harm during planting, the Commission may set conditions on the project, such as requiring erosion controls, limiting the use of heavy machinery in the work area, and ordering the use of native plants only. For more information on the how the WPA may affect your planting work, see Chapter 4.

5. Select Your Plants

A mix of vegetation heights will generally provide the best mitigation for nonpoint source pollution. A mix of grasses, shrubs and trees will impede surface runoff. The deeper and more complex the root system, the better the chances of capturing soluble nutrients and other pollutants in subsurface flow.

If possible, buy plants that have been propagated from native seed and grown in your general vicinity. These plants are already acclimated to your weather conditions. Plants that were started as close as 100 miles south of you may struggle to survive the colder nights and harsher winters in which you are placing them. Likewise, plants used to cooler and moister conditions north of you may struggle under a more intense summer sun.

Buying plants in containers is generally suggested for the general public, due to their wide availability and ease of handling. However, these plants have been grown in an artificial environment and will require more careful planting and watering than other forms of plants. Take care to cut and tease their roots out of the potted soil, to encourage their root systems to expand into their new soil conditions.

Bare-root plants can also be purchased, though these are generally larger in scale and not as readily available in nurseries. Bare-root plants are dug out of their site without soil packed around their roots like container plants. In most cases they can establish themselves quicker because they have larger root systems and because they have been grown in "real" soil, not an artificial soil mix like container plants. Care should be taken to prevent their roots from drying out during the transport and holding of these plants prior to planting.

Larger, field-grown, balled-and-burlaped landscape sized plants can also be used if the budget allows. These plants will provide an immediate benefit to the environment and the aesthetic feel of the property. However, their size and weight make them more difficult to transport and handle.

When selecting plants, tell your nursery owner that you will accept only native, non-invasive species. Many nurseries sell fast-growing and easily maintained invasive species such as Norway maple, burning bush and Japanese barberry. Be alert, and outright ask if the plants you are purchasing are native to your area.

Care should be taken when transporting and holding all plants. If the plants are to be transported for a long distance in the back of a pickup truck, cover them with a tarp to prevent them from drying out. Keep root systems moist during storage and prior to planting. Avoid prolonged storage or holding times in direct sunlight, as plants can become dehydrated easily.

6. Prepare Your Site

Erosion and siltation barriers such as silt fencing and straw bales should always be placed between your work site and the water's edge. This is to prevent sediment-laden runoff from your work area reaching the water in the event that a heavy rain event occurs in the midst of planting. Choose straw bales over hay bales, as there is less of a chance that they will transport weed seed to your site. On sites where new construction has taken place, the soil will probably be loose and exposed. In these cases, simply plant vegetation in the ground. If you want grass around your plantings, seed and cover with straw. If you want a landscaped look, cover the area around your plantings with 2-4 inches of bark mulch. The mulch will prevent erosion of exposed soils, conserve moisture, and help prevent weeds from establishing and competing with your new plants. Use hardwood bark mulch over wood chips, as they are less prone to being washed away in runoff. Avoid using mulch of any kind right along the water's edge, because any mulch can be washed away under heavy rains. Note that it is not necessary, and in fact would be detrimental, to put plastic under mulch as conventional landscapers sometimes advocate. In establishing a buffer, you want to encourage infiltration.

Straw bales protect the water from sediment during a buffer planting.
Source: BRPC archive, 2001.

When the waterfront has lawn or other vegetation and a landscaped look is desired, you will need to remove the existing vegetation to make way for your planting. If you have a relatively small site, this can be done by hand with a grub hoe, manual sod cutter, spading fork or shovel. Either compost the cut sod or use it to patch eroded areas elsewhere on the property.

For larger areas, a machine-powered sod cutter can be a labor-saving tool. These can be rented from garden shops and hardware stores. Care should be taken to save as much of the existing soil as possible. For a very large site, a Bobcat or backhoe can be brought in to remove sod and/or existing vegetation. The use of large, heavy machinery directly along the waterfront area is generally discouraged due to the sensitive nature of the soils and the chance for erosion. Also, heavy equipment can compact the soil, decreasing its capacity for infiltration.

It is not necessary to remove the existing turf in all instances. Many waterfront property owners prefer maintaining an underlying layer of grass while adding a mix of native ferns, wildflowers, shrubs and or shade trees. In these cases, only the turf where new plants will be located will need to be removed.

Once competing sod or undesirable brush has been removed, the area should be lightly tilled or spaded to loosen soil for planting. In most cases, soil amendments such as compost, peat or fertilizers will not be necessary if buffer plants have been properly selected to match the soil and sunlight conditions. However, in some cases, when the original soil has been disturbed or removed and fill has been brought in, it may be necessary to add some compost or organic fertilizer to help the plants get started.

Compost is relatively low in nutrients compared to commercial fertilizers. However, it is beneficial in that it improves the overall condition of the soil. It keeps the soil loose, allowing plant roots to expand outward and extract nutrients from their surroundings. The looser soil also allows for a better exchange of air, greater infiltration of water and an improved habitat for earthworms and soil microbes. In addition, the lower nutrient content of compost decreases the chances that it will leach soluble nutrients into subsurface waters (and ultimately the water body).

7. Planting Your Buffer

Planting can occur at most times of the year. The main factor to be considered is water and its availability for the newly planted vegetation. All new plantings will require some artificial watering during their first growing season, and the time and amount of water is determined by the season you plant. Planting when vegetation is dormant (in the fall or in the very early spring when the environment is cool and moist) requires far less watering than planting during the midst of the warm growing season. In addition, planting in the fall or early spring, when growing processes are shut down, will give the plants time to acclimate to their new surroundings.

Lay out the plants to make sure that you have enough and that they are properly spaced.
Source: BRPC archive, 2001.

Each plant should be planted at the proper soil height, which is the height it was growing in its container or in the field. In general, dig out a hole twice the size of the container or the root system. Place the plant in the hole and fill it back in with soil. If the plants are from containers, save the soil you loosen from the roots and mix it with soil dug out of the ground. This gives the plants a combination of the soil they grew up in and the soil they must become accustomed to. Mulch over the exposed soils around the base of the new plants. Do not place removed turf over the disturbed soil (directly over the roots) for a year or two, as the grass will compete with the new plants for water and nutrients. Thoroughly water the site after planting.

Before you start digging, lay out your plants to make sure you have right number and the right spacing to create the look you desire. Leave enough space between shrubs and trees for them to grow without crowding each other. Although the actual space between shrubs will vary, generally plant them as least 3 feet apart. The space between them can be planted with ferns, flowers or groundcover during the early years. Blue flag iris is an easily grown perennial flower whose leaves grow in a tall and fan shape. These irises can fill in empty spots between newly planted shrubs in the short term. If the buffer is intended to have a landscaped look, you can maintain a permanently mulched planting bed. If the buffer is intended to have an underlying layer of grass, the mulch can be replaced with native grasses once the plants have established themselves, usually within two to three years.

*Blue Flag Iris (*Iris Versicolor*)*
Please Note Yellow Irises (Iris Pseudacorus) are an Invasive Species
Source: BRPC archive, 2003.

Your vegetated buffer should require little maintenance if the plants were carefully selected to meet the soil and sunlight conditions of the site. Watering the first season is the key to success! Also, remove undesirable plants in the buffer, as they will compete with your plants. Once buffer vegetation has become established, after a year or two, consider removing the mulch and allowing grasses and forbs to fill in around your plants. Continue to remove undesirable plants, especially invasive non-native plants. Careful pruning of shrubs and tree branches will help you maintain a view of your lake, pond or river.

Overfertilization is a common problem, and the excess can run off directly into your water body or leach into groundwater. If fertilizers are necessary, avoid their use near the water and use slow-release fertilizers. Also, select the proper season to apply fertilizers, because incorrect timing may render the fertilizer useless or stress vegetation. Do not apply pesticides or fertilizers before or during rain due, to the strong likelihood of runoff.

Consider Outside Help

Designing and planting a vegetated buffer can be a lot of hard work. If you feel that you do not have the knowledge to design your buffer, or that the labor involved is beyond your capacity, consider hiring a local landscape professional. If the cost of a professional is beyond your means, consider contacting local conservation organizations. Once they learn that you are willing to plant a buffer to improve the environment, they may be able to provide low-cost or free technical assistance and labor for a "planting party." The local student conservation organization may be looking for a hands-on project such as your buffer.

Work With Your Neighbors

If your property is in a traditionally landscaped neighborhood along a densely developed shoreline, you should consider discussing your buffer project with your neighbors. Although maintaining shoreline vegetation on a newly developed property is now quite common (and often required), removing turf and planting native vegetation on an existing lot may cause alarm among traditionally minded thinkers. Here are some tips to maintain a healthy and friendly relationship with your neighbors:

- Talk to your neighbors, because what you do will affect them and their shoreline. Explain your goals in planting this buffer.
- Recognize their right to disapprove of your new landscaping ideas, just as you expect them to recognize your right to create a non-traditional yard.

- Talk to the local lake or home owners association, explaining the reasons that you've decided to plant additional vegetation along your shoreline.
- Start small: plant your vegetated buffer in phases to minimize the rate of change. This will not only ease the transition for your neighbors; it will allow you to learn as you go, possibly saving you time, money, and an aching back.
- Consider creating a border around your buffer to give it a more professionally landscaped look. This could be a fence (one that allows wildlife movement), a hedgerow or a border of trees.
- Share your buffer with local conservation groups. Professional experts working with these groups can lend you their support. They may be able to provide you with tips on maintaining the long-term health of your buffer.
- Dare your neighbors to be different! Challenge them to resist keeping that "clean-shaven" lawn right down to the water's edge. If they do not or cannot plant a landscaped buffer, they can simply create a "no mow" zone. This will allow a more diverse mix of vegetation to grow there.

Hopefully, education and time will convince your neighbors and your local landowners association that your vegetated buffer is the landscaping trend of the future.

It will take several buffers, extending along several properties, to truly benefit the water body. Developing such a system of buffers could be done in coordination with neighborhood associations, lake associations and with the municipality in which the water body is located. In areas that are already densely developed, it is important to work with neighboring property owners to develop a shoreline buffer that extends along several lots. A united group of several neighbors may be able to save money by bundling several small buffers into one landscaping contract and purchasing materials in bulk. In areas where a continuous buffer is not feasible, concentrate on planting sections where they will do the most good: in the path of runoff.

After you have become an expert on stormwater runoff from conducting a Rainy Day Survey on your property (see pages 3-17 and 3-18), organize a neighborhood survey. Evaluate runoff from public areas along the shore of your water body. Look for areas in parks and at boat launches and canoe put-ins where stormwater runoff and erosion might be affecting water quality. Look for stormwater discharge pipes that are depositing sand and other pollutants into the water. If you find them, advocate for the creation of a buffer or some other technique to minimize or eliminate the pollution.

Once we acknowledge that we all are part of the problem, we can work together to become part of the solution. Vegetated buffers can be a part of that solution. If there is an open, eroding area along the shoreline, plant a vegetated buffer. If there is a parking lot from which sediment and other pollutants can run directly into the water, plant a buffer. If there is a spot on your property where stormwater runs into the water, plant a buffer. Restoring vegetation along the shoreline will incrementally begin to undo the damage we have wrought with impervious surface areas, lawns and storm drain systems. It might even provide cover for a wild creature in need.

Waterfront Neighbors Work Together for Water Quality - A Case Study

Waterfront property owners on West Boggs Lake in southern Indiana are jointly enrolled in a unique program to mitigate problems related to nonpoint source pollution. The 622-acre recreational lake suffered from the types of degradation that many lakes in Massachusetts suffer from: high turbidity, persistent algae blooms, extremely high nutrient loads, and high bacteria counts. Under the Buffer Management Program, established in 1994, the Parks and Recreation Department purchased a 100-foot-wide buffer zone around the lake from the private lakefront owners. Private property owners who abut the buffer must apply for permits and pay fees for day-to-day uses that negatively impact the lake's water quality. For instance, they must apply for special permits to mow, fertilize, or remove trees in the buffer, or to erect a boating dock. Applying pesticides is strictly regulated. Violations of permit conditions can result in the ultimate loss of use of any buffer zone land. The buffer lands in question would be allowed to revert back to a natural state to act as a filter strip for irresponsible land uses. User fees remain within the Buffer Management Program. Although private lakefront owners initially resisted the purchase of land and the development and implementation of buffer zone regulations, most have since changed their opinion, because personal property values along the lake have risen dramatically (Axsom, 1999).

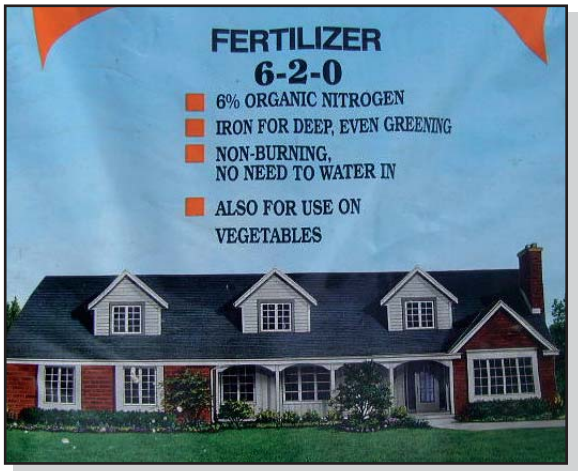
These native shrubs have been planted along the shore of public lake to act as a buffer between a hiking trail and the water to filter runoff.
Source: BRPC archive, 2002

The regulations on West Boggs Lake may seem stringent, but lake associations, lake districts and municipalities can develop protective measures to mitigate pollution and encourage vegetated buffers. This can routinely be done in development or redevelopment projects situated along waterfront properties.

More Helpful Hints

A Few Words About Fertilizers

Plants need a number of nutrients to flourish. The nutrients that they require in relatively large amounts are nitrogen, phosphorus, and potassium. Nitrogen is associated with lush vegetative growth, phosphorus is needed for flowering and fruiting, and potassium is necessary for structure and durability. Although these nutrients are valuable in soil, they end up feeding algae and noxious weeds if they end up in water bodies. Phosphorus is the nutrient of most concern in freshwater systems, while nitrogen is the nutrient of most concern in salt-water systems. So the goal is to maintain nutrients in the soil and keep them out of your lake or pond.



This is the label of a popular lawn fertilizer called Milorganite. The formulation for this fertilizer is 6% nitrogen, 2% phosphorus, 0% potassium. Photo: BRPC archive, 2003.

In general, most Massachusetts soils already have enough phosphorus to feed plants, so adding fertilizer may overdo it. The typical fertilizer formulation is a set of three numbers, with each number representing the percentage of the three in main nutrients in fertilizer. The first number represents nitrogen (N), the second phosphorus (P), and the third potassium (K). So, a common fertilizer of 6-2-0 would be 6% N, 2% P, and 0% K.

Source: National Association of Conservation Districts, Wildlife Habitat Council

Phosphorus-free fertilizers are best for areas near freshwater bodies and you should try not to go over 3% P (nitrogen-free fertilizers are best for saltwater bodies). In fact lawns, which are the most heavily fertilized areas, need higher amounts of nitrogen than phosphorus, so a 6-2-0 formula will benefit lawns while minimizing the chance that phosphorus will leach into your lake. Better yet, just leave grass clippings on the lawn after mowing - they are largely nitrogen and leaving them is a cheap fertilizer.

If you feel that your soil is not fertile enough, here are some tips to determine what, if any, nutrients are lacking, and on using fertilizers if necessary.

- Conduct a soil test to see if indeed your soil is lacking the proper nutrients. Soil test kits can be purchased at garden centers. These tests are not as reliable as those that can be done by the Cooperative Extension Service, but they should give you a general idea of what your nutrient levels are.
- Follow the soil test kit directions closely! Human error is the main cause of faulty soil readings.

- Make sure your shovel and other tools are clean for each test. Residuals from past projects that involved compost or fertilizers will skew the test results.
- Dig into the soil at least 6 inches to get beyond the root system of existing plants.

If you determine that you need to add nutrients to your soil, here are some tips:

- Consider using compost instead of fertilizer. Compost nutrient levels are generally lower than those in fertilizers, but compost releases those nutrients more slowly, giving plants more of a chance to absorb all or most of it. This in turn makes it less likely that nutrients will leach into the water body.
- If fertilizer application is necessary, do so under dry conditions. Fertilizer nutrients travel easily in runoff.
- Most fertilizers have more nutrients than you will need. So, apply conservatively; this will save your lake and your wallet.
- At most, apply no more than one pound of fertilizer per 1,000 square feet of lawn.
- Avoid applying fertilizer near the water's edge, where it can easily be washed into your stream or lake.
- Also avoid applying fertilizer near sidewalks, driveways and roads, where runoff can easily carry it through the storm drain system and into your water body.

Maine and Minnesota Work to Limit Phosphorus Fertilizer Use

In 1999 the state of Maine began promoting the use of phosphorus-free fertilizers to protect and improve the health of its recreational lakes, many of which have become degraded due to algae blooms, noxious weeds and lower oxygen levels. Impressively, the lawn care and fertilizer industry joined in the effort, and sales of phosphorus-free products skyrocketed. Approximately 3,200 pounds of P-free fertilizers was sold in 1998. Sales jumped to 56,445 pounds in 1999 and reached 134,590 pounds in 2001. Phosphorus-free fertilizers are available in Massachusetts - you just have to ask for them.

It is estimated that 80% of the lawns in Minnesota are already saturated with phosphorus (Barten). To protect water quality, the state passed a law in 2002 that bans the use of phosphorus on most lawns in seven counties around the St. Paul area. Fertilizers are allowed to be used only in establishing new lawns or where soil tests have indicated a need. Where fertilizers are allowed to be used, the phosphorus content is limited to a maximum of 3% of content. Some communities outside the St. Paul area, convinced that phosphorous was a problem for local lakes, developed local bans of their own. The city of Plymouth established a ban on phosphorus in 1996, after which the water clarity in its recreational lake improved dramatically. A 2001 comparative analysis was conducted on runoff from Plymouth and runoff from a neighboring city, one with similar watershed characteristics and which had not banned phosphorous fertilizers. The results showed that Plymouth's phosphorus content had been reduced by 23%.

Choose Native Plants

Choose native plants for buffer areas. They provide local wildlife with familiar food sources and habitats. Avoid invasive plants, which can become pests. Because of their propensity for reproduction, invasive plants can overrun native vegetation and result in a decrease in native plant diversity. Consequently, biodiversity (variability in animal life) is compromised by invasive plants. Globally, 42% of all threatened or endangered species are at risk of extinction due to the spread of invasive plant species (TNC, 2002).

Typical native upland trees, shrubs and wildflowers serve as a variety of food sources for game species. Hardwoods such as oaks, hickory, beech and hop hornbeam produce mast (nuts and acorns) that grouse, turkey, wood ducks, deer and black bear depend on for survival. Ferns, skunk cabbage and other early-emerging herbaceous vegetation provide much-needed nutrition after a long and hard winter. Native berry-producing shrubs such as blueberry, raspberry, dogwoods, shadbush and viburnum produce berries eaten by bear, fox, and coyote, as well as by many smaller mammals and birds. Berries are an important source of energy for migrating songbirds during late summer and autumn. An extensive list of native plants and their value for wildlife can be found in Appendix B.

Negative Impacts of Invasive Plants on Wildlife

Many invasive shrub species produce berries that are unhealthy for local birds and other animals. Invasive species such as Japanese barberry, oriental bittersweet, buckthorn and burning bush produce large berry supplies. Because many of these plants produce berries late in the season, they would seem like a good food source for wild animals facing a long, cold winter. Not so. Many animals are not able to digest non-native fruits and so are not able to receive nutrition from them. In fact, the fruit from some non-native plants, such as buckthorn, actually acts as a diuretic in certain songbirds, robbing them of much-needed nutrition.

To Learn more about invasive plant species, visit The Nature Conservancy's website: *www.lastgreatplaces.org/berkshire/issuues/art6406.htm*

Once established, invasive plants are stubborn. Landowners may be forced to use herbicides in order to control them. Because there is a chance that herbicides could find their way into a nearby water body, especially if used in close proximity to the shore, it is best to avoid their use whenever possible.

Despite the threat they pose to our natural environment, many non-native plants are still being sold at nurseries across Massachusetts. Most people, including some nursery workers and owners, would be surprised to learn that many popular trees (Norway maple, black locust), shrubs (burning bush, Japanese barberry, many honeysuckles) and other plants (yellow iris, oriental bittersweet, goutweed) are actually invasive. Therefore, it is important to visit the nursery armed with information. If you have several nurseries from which to choose, try to support those that offer and promote the use of native plants.

Finally, in choosing the types of species for planting, let Mother Nature be your guide. Look at the assemblage of grasses, ferns, flowers, shrubs and trees along a natural stretch of the shoreline that has the same characteristics as your unbuffered area. If these plants flourish in neighboring areas, chances are good that they'll flourish on your property, too. An extensive list of native trees, shrubs and ground covers can be found in Appendix B.

*Northern arrowwood (*Viburnum recognitum*) can be used as a stand alone shrub or can be used to create a hedge. Showy white flowers bloom in June and dark black berries ripen in late summer.* ▶
Source: BRPC archive, 2003

*Thorny blackberry bushes (*Rubus Allegheniensis*) can be used to create a barrier to trespassers. They have white flowers in late spring and black raspberries in summer.* ▶
Source: BRPC archive, 2003.

Conduct a Rainy Day Survey to Identify Runoff Problems on Your Property

You can identify runoff-problem areas on your property by conducting a Rainy Day Survey. Simply observe your land during a heavy rainstorm and note the problem areas. Use the checklist below to help you detect problem areas. The map you create will provide a bird's-eye view of your existing property and will provide a place to sketch new landscaping ideas. Visit our Site Maps in Chapter 5 for ideas.

1. Create a Map of Your Property

- Outline the footprint of large structures (house, patio/deck, garage, storage sheds, gazebo, dog-house), vehicle areas (driveway, parking spots), activity areas (beach, dock, canoe launch, playground, pool, horseshoe pit, gardens) and other areas of importance (paths, walkways).
- Use an assessor's map if possible, because it may already show the location and size of buildings.
- Outline large trees and other areas of vegetation.

2. Get Your Rain Gear Out

With map in hand, conduct your survey once the ground is soaked and water has saturated the soil and leaf litter. It is then that runoff is more easily observed. We suggest that you start at the water's edge and work your way inland. Where does stormwater flow? Does it all flow towards the lake? Does some of it flow elsewhere, like into the town storm drain system? Mark the pathways of runoff to their final destination. Use this checklist to help you survey your land and map your problem areas.

In the water along shore

Mark these on your map:

- ☐ Sandy or muddy deposits in the water. The sand or mud has been transported by runoff, so mark the pathway it followed to get there.
- ☐ Eroding bank
- ☐ Discharge pipes. Identify the origin of the discharge and mark the pathway it followed, if possible. Note color of discharge from pipe (if any).

On land

Mark these on your map:

- ☐ Sandy or muddy deposits. Mark the pathway the sand or mud followed to get there.
- ☐ Bare unvegetated patches
- ☐ Ditches or gullies
- ☐ Pathways, boat launches, driveways
- ☐ Drain spout for roof runoff. How far does the runoff travel? Is it channelized? If so, mark its path.
- ☐ Discharge pipes. Identify the origin of the discharge and mark the path way if followed, if possible. Note color of discharge from pipe (if any).
- ☐ Areas of gas, oil, or other vehicle leaks
- ☐ Areas waterfowl frequent
- ☐ Arrows to show direction of runoff

3. Evaluate Your Problem Areas and Consider New Ideas

Using your map, look at your problem areas and consider ways to fix them.

- Plant a vegetated buffer along your shoreline (of course!) to filter and disperse runoff.
- Revegetate bare and eroded areas.
- Create berms or plant vegetated buffers around hard surfaces.
- Replace concrete or blacktop surfaces with "porous pavement," such as bricks or stones that allow some infiltration through the cracks.
- Install a dry well or rain barrel to capture roof runoff.
- Replace dirt pathways with grassed ways.
- Eliminate direct discharges and redirect runoff through vegetated areas.
- Relocate sediment-generating areas such as pathways, driveways and gardens as far away from the water's edge as possible.
- Relocate pollution-generating areas such as fertilizing, car washing, pet walking (and pooping) as far away from the water's edge as possible.
- Replace a portion of your beach area with vegetation.

4. Prioritize Your Problems for Corrective Action.

Problems that directly affect water quality, such as those located along the shoreline or where muddy or cloudy runoff is reaching the water body, should be ranked highest on your list. This includes runoff traveling in ditches, gullies and storm drain systems.

Chapter 4

Buffer Plantings and the Massachusetts Wetlands Protection Act

Buffer Plantings and the Massachusetts Wetlands Protection Act Regulations

The term "vegetative buffer," as used thus far in this manual, is somewhat different from the meaning of the term "buffer zone" under the Massachusetts Wetlands Protection Act (WPA) regulations. A vegetative buffer, as used is this manual, is a planted area along a water body that functions to filter runoff, capture pollutants before they reach nearby waterbodies, and provide wildlife habitat. It does not have any regulatory connotations.

A "buffer zone" in Massachusetts, however, does have regulatory implications. A buffer zone is an area 100 feet wide along the bank of a lake, pond or wetland. Development and other human activities that negatively impact the water resource or wetland are restricted within this area. Activities that are allowed within this area are regulated by the local Conservation Commission and the Department of Environmental Protection (DEP). Understanding the WPA and following its regulations are important, so it is recommended that you visit your local Commission to discuss your buffer plans before you begin planting. They will advise you as to whether you need to file any forms or apply for any local or state permits. In addition, some communities have adopted local bylaws that may be more restrictive than the state regulations. Your local Commission will explain these to you when it explains the state regulations to you. In general, restoring vegetation along the shoreline is beneficial for the environment and follows the intent of the WPA.

Local Conservation Commission Responsibilities

In general, planting of vegetative buffers is considered a valuable project that helps the Commission in its efforts to protect water and wetland resource areas. There are five inland (freshwater) resource areas that fall under the jurisdiction of the Conservation Commission and the WPA:

1) banks of lakes, ponds, streams and rivers
2) wetlands (swamps, bogs, marshes) that border on a water or wetland resource
3) land under any water body
4) land subject to flooding (100-year floodplain)
5) 200-foot riverfront area along perennial streams and rivers

It is the responsibility of each local Conservation Commission to review projects within these specific wetland resource areas and enforce the protective WPA regulations. The Commission is composed of a board of up to seven volunteers with a variety of backgrounds, knowledge and experience, such as farmers, businesspeople, home owners, professors, environmental consultants, and engineers. Although their primary role is enforcing the wetland regulations, they can be a great resource for information when you are designing your vegetative buffer, as well as help you understand the wetland review and permit process. The Commission can also provide you with information on the various exemptions that, if your project qualifies, will allow you to perform the work without first receiving a permit from them.

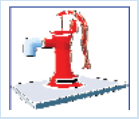
A copy of both the Massachusetts WPA and its regulations can be found at the DEP website http://www.state.ma.us/dep/brp/ww/regs.htm. They can also be obtained from your local Conservation Commission or be viewed at your local library.

The local Commission's role is to protect the eight public interests that are listed in the WPA regulations, as they relate to jurisdictional wetland resource areas. The eight interests protect the quality of life for all of the residents in the Commonwealth.

The Eight Interests

Protection of public and private water supply

Prevention of pollution



Protection of groundwater supply

Protection of land containing shellfish

Flood control

Protection of fisheries

Prevention of storm damage

Protection of wildlife habitat

Local Bylaws

Another reason for meeting with your local Conservation Commission is that there may be local wetland bylaws that you need to be aware of. Knowing what these might be will help you better design your buffer and meet these requirements. Some types of work that may qualify for an exemption under the state regulations may not be exempt under a local bylaw. This is because local bylaws are more restrictive than the state law. For example, many towns have adopted bylaws that extend the width of the buffer zone past 100 feet, add a 100-foot-or-greater buffer zone to other environmentally sensitive areas not covered under the WPA regulations, give added protection to vernal pools, or extend the Commission's jurisdiction in other ways.

4-2 Buffer plantings

Exempt Minor Activities

Planting vegetated buffers along water bodies is generally an "exempt minor activity" under the WPA regulations. The DEP has put together a fact sheet titled "Exempt Minor Activities in Riverfront Areas and Buffer Zones" that outlines certain types of minor projects that do not require a filing with the Conservation Commission when they are located in the buffer zone and/or the Riverfront Area (see Appendix E). Please note that the same minor activities proposed in other wetland resource areas, including the land under water or stream or riverbanks, are not exempt. It is important to keep in mind that some types of work which may qualify for an exemption under the state regulations may not be exempt under a local bylaw.

What Procedures Should I Go Through?

1. Request a pre-permitting meeting with the Conservation Commission.

Some Commissions (not all) will review informally your proposed project at one of their regular meetings prior to submission of an application, to give you suggestions and discuss areas of concern. Call ahead to find out if this is possible. The purpose of the pre-permitting meeting is only informational. Bring with you any information that you may have about the site and the work you wish to do. On an assessor's map or plot plan, sketch a planting plan that shows the area and extent of the planting, and the plant species that you have selected. Also bring any photographs of the area you may have.

2. Check with your local Commission about any local bylaws and application fees

Calling ahead to find out this information can ensure that your application is not held up due to submittal of insufficient fees or lacking a legal ad fee. Knowing what local bylaws your town has adopted will help you better design the project and meet these requirements. Some types of work that may qualify for an exemption under the state regulations may not be exempt under a local bylaw. This is because local bylaws are generally more restrictive than the state law.

3. File a Request for Determination Application

The Conservation Commission may require that you file a Request for Determination application, which includes a clear and detailed plan of work. This process was designed so that you can formally and fairly easily ask the Commission to determine whether or not the WPA regulations apply to your buffer planting. Following this process will protect you if you are unsure of whether or not your site or work is under the jurisdiction of the Commission. It may give you peace of mind to have the decision made by the Commission and have the piece of paper in hand. If you are confident that your site is out of the Commission's jurisdiction - that your work is not in a buffer zone or wetland resource area, or that your work qualifies for one of the exemptions - you may proceed with work at your own risk. However, be aware that should you be mistaken, the Conservation Commission can order you to stop work and restore the site to pre-construction conditions at your own expense.

Generally, planting vegetated buffers receives a "Negative Determination." Although this sounds ominous, it is a good thing; it means that your work will not negatively impact the water resource or the buffer zone and you can proceed with planting. The Commission may impose "conditions" on your project, such as erosion control measures (e.g. installing hay bales and silt fencing between the work and the waterbody, covering exposed soils to prevent sedimentation). You must comply with these conditions.

4. Read the instructions

The Request for Determination (WPA Form 1) and Notice of Intent (WPA Form 3) forms come with very detailed instructions. The instructions and the application forms are available from the DEP website http://www.state.ma.us/dep/appkits/forms.htm or from your local Conservation Commission office. Be sure to include all information that is required in the instructions, including a detailed description of the site and proposed work, a plan showing existing and proposed conditions, and adequate information for the Commission to locate the site.

5. Attend the Conservation Commission meeting and any site meetings

The Commission may request an on-site meeting to answer questions they may have. Questions and modifications that may be required can often be addressed at the site. Your presence will help facilitate and speed up the process. Bring copies of all your information and any alternatives that you may have considered to discuss with the Commission.

6. Consider hiring a consultant

If your buffer planting project is unusually large, you might consider hiring a consultant experienced in wetland permitting. Hiring a landscape architect or wetland consultant from the start may save time and money in the long run. Knowing where the buffer zone and wetland resource areas are located is essential to a well-designed project and often avoids delays in the application process due to project changes forced by inaccurate delineations. A consultant may also help you determine if the proposed work is exempt or suggest modifications that would help the work qualify for an exemption. Keep in mind that the delineation of any resource areas is not final until it is approved by the Conservation Commission.

Tips for Meeting the Minor Activities Exemptions

Keep in mind that seemingly simple modifications to your buffer may possibly make a non-exempt project into an exempt one. For example, changing your proposed planting plan to include only native species, or agreeing to cover exposed soils during planting of the buffer may produce this result. These modifications may include the following:

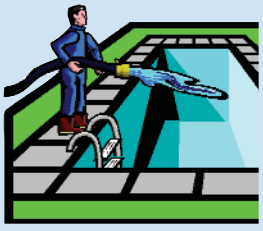
1) Unpaved pedestrian walkways for private use. Note that this does not include paved walkways, bike paths, or other public use paths.

2) Fencing that does not create a barrier to wildlife movement. You may wish to review with the Conservation Commission the type and extent of fencing that you are proposing, in order to make sure that the Commission does not determine that it will create a barrier to wildlife movement. Some things to consider are the length and height of the fencing, current wildlife corridor usage, fence material, and spacing that will allow wildlife to safely pass through, over and under it.

3) Vista pruning (the selective thinning of tree branches or understory shrubs to create a "window" to improve visibility), as long as it occurs more than 50 feet from the mean annual high water line within a riverfront area or from a bordering vegetated wetland, whichever is farther. This activity does not include the cutting of trees that reduces the leaf canopy to less than 90% of the existing crown cover, or the mowing or removal of understory brush.

You will need to know where the mean annual high-water line and boundary of the bordering vegetated wetland are to ensure that you meet the requirements for this exemption. If there is any question as to their location, you should consider filing a Request for Determination application with the Conservation Commission.

4) Plantings of native trees, shrubs, or ground cover, but not turf lawns. Note that this exemption does not include planting of non-native exotic species or lawn grasses.



5) Conversion of patios, pools, sheds, or other impervious surfaces to lawn or natural vegetation. This type of work is generally viewed as an improvement to the area that will help protect the wetland resource area. Note: Maintenance of existing landscaping, including lawn mowing and pruning, is exempt from review regardless of location in the buffer zone or any wetland resource area.

Chapter

5

Unfold Your Imagination and Redesign Your Property

Our Imaginary Waterfront Property

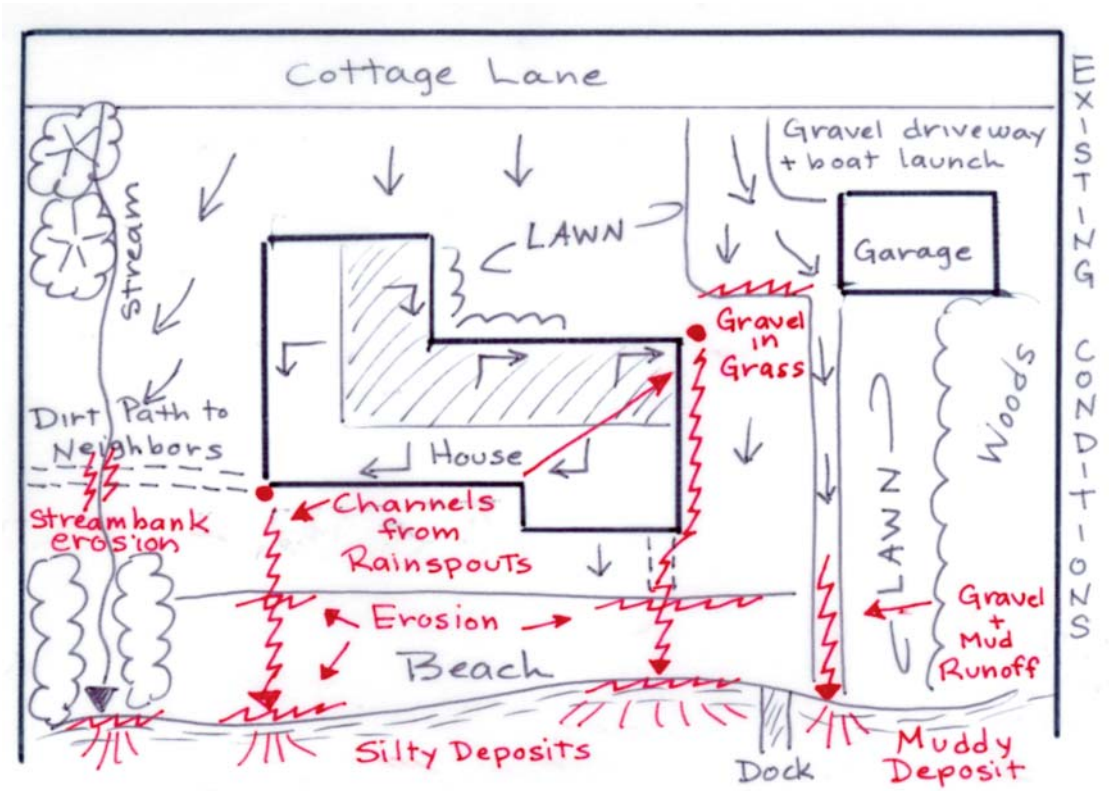
Wondering how to get started on designing your vegetated buffer? We've created a sample of what a typical Site Map, produced during a Rainy Day Survey, might look like. It shows the current condition of a waterfront property, including problematic erosion and runoff.

We have also created a sample Site Map of future ideas and goals for the property. As we discussed earlier, sediment is a major transporter of nutrients, bacteria and other pollutants, so these are the areas on which the owners should focus their attention. We hope you find these samples helpful as you design your own buffer project.

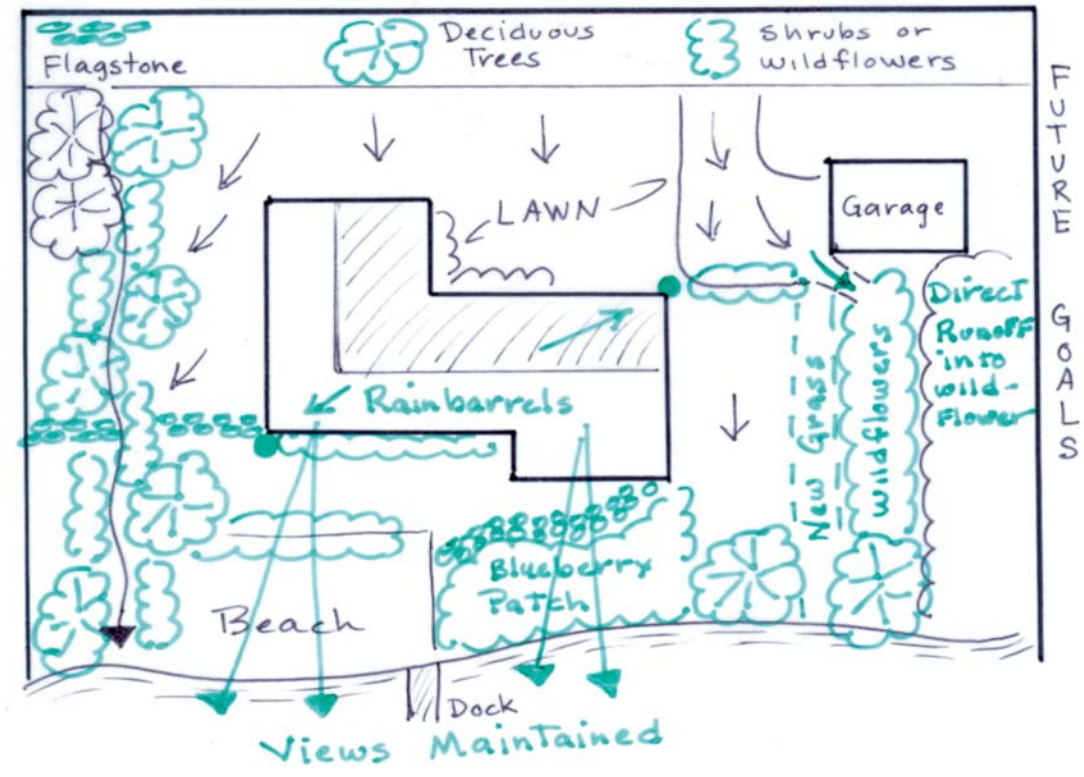
Existing Conditions

The property consists of a modest house on a small building lot. Most of the natural tree cover has been removed. A grass lawn surrounds the house and a sandy beach runs along the full length of the water-front. The owners conducted a Rainy Day Survey and found these problem areas:

- Informal dirt pathways have been created from heavy use. These include one from the house to the beach and one from the house to the neighbors' property.
- The streambank is eroded where people travel between the two properties.
- The stream has no shading or cover for wildlife.
- Channels have formed in the lawn and on the beach from roof runoff being discharged through the drain spouts. As a result, the soil along the edge of the beach is eroding and the beach sand is being washed into the lake at an accelerated rate.
- The gravel driveway and boat launch often wash out during heavy storms. Gravel from the driveway washes into the grass, sending dirt and stones flying during mowing. Gravel and mud have formed a delta in the lake, making boat launching difficult and unpleasant.



Artist renderings supplied by Okerstrom Lang, Ltd., 2003



New Ideas and Future Goals

- Lay flagstone along the informal dirt pathway between the house and the neighbors' property. Plant grass seed in the spaces between the stones. The grass will hold soil particles and allow rain to percolate into the ground.
- Plant vegetation along the streambank. A mix of trees and shrubs will shade the water and provide cover for wildlife. Deciduous trees provide cooling shade in the summer while allowing warm solar rays onto the house in the winter. The shrubs we chose are Northern Arrowwood, which will form a nice dense hedge with white flowers blooming in mid-summer. The cattails at the water's edge will filter sediment, break the force of waves and wakes, and provide food and cover for wildlife.
- Place rainbarrels to capture roof runoff and provide water for the newly planted vegetation.
- Plant a hedge of shrubs along the boundary between the lawn and the beach. The shrubs provide a landscaped look while helping to bind the soil. The view of the lake from the house is maintained by the low-growing shrubs.
- Replace the informal dirt path from the deck with a curved path of flagstones and grass. The curved design reduces the chance that runoff will form another channel.
- Create a small berm along the lower edge of the driveway and plant shrubs along it. The berm keeps gravel from washing onto the grass and the shrubs will filter overflow during heavy storms. Shrubs will also add a landscaped look to the area.
- Channel driveway runoff through a grassy swale into an area dense with wildflowers. The vegetation will filter runoff and attract songbirds and butterflies. The flowers will add color and depth to the dark green back-ground of mature trees.
- Replace the gravel boat launch with a grassed area. The launch is only used a few times per year, so gravel really isn't necessary.
- Reduce the size of the beach, replacing a portion of it with low-bush blueberries. The bushes will filter runoff from the path and provide fresh fruit, while still maintaining a view of the water from the house.
- Plant trees along each side of the property. The trees will frame the view of the lake from the house; likewise they will frame the house when being viewed from the lake.
- Overall, the appearance of the property is richer, as the vegetation adds a variety of depth and color. In addition, the value of the property is greater, as landscaped properties with mature trees are worth up to 20% more on the real estate market (Fitzpatrick, 2002).

I've planted my buffer - What else can I do?

Now that you understand the role that vegetated buffers play in protecting water quality and providing habitat, we hope that you will share your knowledge with your neighbors, homeowners association, local officials and anyone else who manages land along your stream, river, lake or pond. Here are additional tips to reduce runoff from your property, so that even a relatively narrow buffer will do some good.

- Conduct a Rainy Day Survey of your property. This will help you to determine runoff problems and prioritize improvements. If you are limited as to where you can put a buffer and how wide a buffer you can design, place the buffer in the direct path of stormwater runoff.
- Minimize impervious surfaces wherever practical. Consider replacing blacktop or concrete driveways and walkways with stone or "porous pavement" alternatives that allow some infiltration. Build a wood deck with open slats instead of a concrete pad for your patio.
- Allow the grass to grow to a lush height of 3-4 inches. This will encourage a deeper and thicker root mass that will better resist drought and weeds. It will also improve the capacity of the grass to filter sediment and promote sheet flow.
- Do not allow mowed grass to enter the water. Grass is easily broken down and the nutrients from it can cause algae blooms and accelerated weed growth. This leads to lower oxygen levels for aquatic animals and can cause noxious odors.
- Minimize exposed soils, especially along the water's edge. Revegetate eroded areas like dirt paths, bare slopes and exposed tree roots. Consider replacing dirt paths and driveways with grassed ways. If slopes are severe and stormwater tends to create channels, try constructing wood or stone steps.
- Eliminate direct discharges from your property into the water body. Install a dry well to capture rooftop runoff. Or capture roof runoff in a barrel or cistern and use it to water your lawn and buffer and for washing your car. Redirect gutter drains, driveway ditches, and other channels or pipes through grassed swales or thick vegetation so water can be filtered, or redirect them into low-lying areas so the water can collect and percolate into the soil.
- Do not wash pet waste or direct nutrient-laden water (car wash detergent, fertilizers) into the storm drain system. Chances are, the system collects runoff from your neighborhood and discharges it untreated into your lake somewhere down the line.
- If you must water your lawn or buffer, use slow-watering techniques such as trickle irrigation or soaker hoses. Such devices reduce runoff and are 20% more effective than sprinklers.
- Create berms or plant vegetated buffers around impervious surfaces to hold back runoff and capture pollutants. These berms and buffers can be disguised as flower beds or shrub hedges.
- Minimize your phosphorus use by purchasing fertilizers and detergents that have no or little (less than 1%) phosphorous content. Phosphate content in various dishwashing detergents sold in the state ranges from 0% to 8.7% by weight. Gel detergents tend to have less phosphorous than powder detergents (MA DEP, 2001a).
- Maximize the amount of natural vegetation on the property, especially along the water's edge, to buffer the lake from runoff from human activity. A mix of grasses, leaf litter, shrubs, and trees will impede sediment transfer and capture pollutants (such as nutrients) in runoff.
- Maintain mature trees if possible. Careful pruning of tree branches will frame your view of the lake while maintaining the protection that tree foliage provides.
- Resist the urge to tidy up your buffer. Woody debris and leaf litter enable infiltration, and the cavities of dead trees and fallen logs provide cover for wildlife.

5-3 Unfold Your Imagination

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Selected Internet Resources on Vegetated Buffers

This internet resource list was prepared by Russ Cohen of the Riverways Program, within the Massachusetts Department of Fisheries and Wildlife and Environmental Law Enforcement. Russ has graciously provided comments on the merits of each website. Enjoy your search.

- Riparian Buffers fact sheets, prepared by the Connecticut River Joint Commissions (CRJC) of VT/NH.: <http://www.crjc.org/riparianbuffers.htm> [NOTE: These are excellent. If you don't look at any other reference materials listed in this document, be sure to check out this one.]
- Riparian buffer fact sheets on the functions and values of naturally vegetated riparian areas, prepared by Russ Cohen, Riverways Programs: <http://www.state.ma.us/dfwele/river/rivfstoc.htm.>
- Impacts of Development on waterways. Center for Watershed Protection (CWP) and the Stormwater Manager's Resource Center (SMRC) <http://www.cwp.org> and <http://www.stormwatercenter.net> [CWP is one of the country's best resources on protecting streams and watersheds from the adverse impacts of development. CWP's web site provides advice on buffer design as well as model ordinances requiring the establishment and/or retention of vegetated buffers along waterways. It is also worth looking at two articles on CWP's web site entitled "The Architecture of Urban Stream Buffers" and "Invisibility of Stream/Wetland Buffers: Can Their Integrity be Maintained?".]
- Massachusetts Wetlands Protection Act Regulations: <http://www.state.ma.us/dep/brp/ww/files/310cmr10.pdf> [Note: The section referring to the Riverfront Area resource area is at pp.81-92; the preface discussing the 12/20/02 amendment to the WPA regulations relating to "perennial vs. intermittent" can be found at pp.1-4.]
- "A Homeowner's Guide to Nonpoint Source Pollution", also put out by the Connecticut River Joint Commissions: <http://www.crjc.org/pdffiles/homeguide.pdf>
- Riparian Forest Buffer information from the Chesapeake Bay Program: <http://www.chesapeakebay.net/info/forestbuff.cfm> [NOTE: under the "Publications" section on this page you will find a link to a .pdf version of a 481-page document entitled "Chesapeake Bay Riparian Handbook: A Guide for Establishing & Maintaining Riparian Forest Buffers". An excellent resource, often cited in this manual.]
- "Why Restoring Shoreland Vegetation is Important" [and how to do it] - from Wisconsin Cooperative Extension: <http://www.uwex.edu/ces/shoreland/Why2/whyres.htm.>
- Research on Shoreland Systems, from Wisconsin DNR - a wealth of information + hot links to research papers on the value of vegetated shorelines for water quality and other functions: <http://www.dnr.state.wi.us/org/water/wm/dsfm/shore/research.htm>

- "Riparian Areas: Functions and Strategies for Management" <http://books.nap.edu/books/0309082951/html/index.html> [This is the title of a new book produced by the well-respected National Academy Press and National Research Council. An on-line version of the book may be viewed for free on-line at this Web address. A description of the research project that led to the publication of this book can be read at <http://www4.nas.edu/webcr.nsf/ProjectScopeDisplay/WSTB-U-98-01-A>. I have not yet had a chance to review this information in detail, but from the looks of it, it is a carefully and extensively researched publication put together by an impressive team of experts on the topic.]
- "The Use of Riparian Buffers to Reduce Nonpoint Source Pollution from Development", a report to the Maine Legislature's Joint Standing Committee: <http://www.state.me.us/dep/blwq/report/buffer.pdf>
- "Width of Riparian Zone for Birds", a very good research paper prepared by the U.S. Army Corps of Engineers: <http://www.wes.army.mil/el/emrrp/pdf/si09.pdf>
- "Streamside Science" information from the state of Oregon: <http://www.oacd.org/fs05stbu.htm> and <http://www.planning.ci.portland.or.us/pdf/hps_sci_sum.pdf>
- "The space between: Lying at the edge of land and water, riparian habitats play a crucial role in the ecosystem" - article appearing in the Gulf of Maine Times, Fall 2002: <http://www.gulfofmaine.org/times/fall2002/science_insights.html>
- "Understanding the Science Behind Riparian Forest Buffers: Effects on Water Quality", from Virginia Cooperative Extension: <http://www.ext.vt.edu/pubs/forestry/420-151/420-151.html>
- Buffer fact sheets and other source materials from the State of Maryland: <http://www.riparianbuffers.umd.edu/home.html> and <http://www.agnr.umd.edu/MCE/Publications/Category.cfm?ID=8&top=32> (see documents FS 724-FS 733)
- "Riparian Forest Revegetation for Water Quality Improvement" - from Minnesota: <http://www.hort.agri.umn.edu/h5015/97papers/hanson.html>
- Healthy lawns and gardens without chemicals brochure and demonstration plot, Marblehead, MA: <http://208.56.92.121/community.old/PDF/Lawn.pdf >
- Why Phosphorous is a problem and what to do about it, from the New York State Federation of Lake Associations: <http://www.nysfola.org/phosphorus/>

And, last but not least:

- List of Native Plant Species Suitable for Planting in Riparian Areas in Mass., prepared by Russ Cohen: <http://www.state.ma.us/dfwele/river/pdf/rivSp01NL.pdf> [Note: A similar document prepared by Michael Abell of DEP is awaiting final approval by DEP Boston.] If you are interested in edible native plants, visit this site.

Glossary

Glossary

Ecosystem: an environmental community, based upon the interaction between climate, soil, topography, plants and animals. When functioning, this system is self-sustaining.

Edge habitat: the area where two or more habitat types, such as forestland, grassland, or wetland, meet is called edge. Edge habitat is a place where plants and animals from each of the adjoining habitats mix.

Effluent: wastewater from a septic system or wastewater treatment plant that enters a water body.

First flush: the first half inch to 1 inch of precipitation that accumulates and becomes stormwater runoff. First flush runoff gathers pollution as it washes the earth's surface, and as such it carries the highest concentration of pollutants.

Food chain: a sequence of organisms in which each is the food of the next organism in the sequence. For example, in an aquatic system, a young mosquito is food for a trout, which is food for an osprey.

Food web: all the interconnected and circular food chains in an ecosystem. This system is more inclusive and reflective of an ecosystem than the simpler food chain. For example, if the young mosquito mentioned above escapes the trout, it may later be food for a frog, which is food for a fox. Or the mosquito may escape all of the above and prey upon humans, which then allows it to complete its life cycle and lay eggs in the nearest water body.

Forbs: non woody vegetation including grasses, flowers and ferns.

Habitat: an organism's home, including areas that provide cover, food, shelter, water and breeding sites.

Infiltration: percolation of water and chemicals through the soil.

Ion: an atom or molecule that carries a net charge (negative or positive).

Microorganisms: organisms so small that they are invisible to the human eye.

Nonpoint Source Pollution: diffuse pollution being delivered to a waterbody with no discernible pathway. Whereas "point" sources of pollution, such as pipes or ditches, can be easily pointed to, Nonpoint Source Pollution often travels in runoff and is invisible, so that it is not so easily pointed to.

Retention time: the time it takes for water to travel from its original source to a receiving waterbody or other specific point. The water can travel in surface runoff, streams, rivers, or subsurface flows.

Sheet flow: runoff that flows over the ground as a thin, even layer rather then concentrated in a channel.

Soluble nutrients: nutrients dissolved in water or other solution. Soluble nutrients such as phosphorus and nitrogen are in forms that can readily be used by plants. The presence of soluble nutrients can have an immediate effect on algae and plant growth in water bodies.

Stormwater runoff: overland flow of water due to rainstorms or snowmelt

Subsurface flow: the underground flow of water through soil or bedrock. This flow moves down gradient, often heading toward surface water bodies. It is often an important source of recharge water in times of low rainfall or drought.

Transpiration: the uptake of water by plants, which they then use in life processes and give off as moisture through their pores.

Vegetated buffer: an area of natural vegetation along the shoreline of a water body or wetland, buffering that resource from human activity

Velocity: speed of movement.

Vernal pool: Vernal pools (also known as ephemeral pools and temporary woodland ponds) typically fill with water in winter due to rising groundwater and rainfall and remain filled through the spring and into summer. Vernal pools usually dry completely by the middle or end of summer each year, or at least every few years. Occasional drying prevents fish from establishing permanent populations. Many amphibian and invertebrate species rely on breeding habitat that is free of fish predators.

Water bodies: a generic term used throughout this manual, referring to rivers, streams, lakes and ponds

Watershed: The area of land from which all surface water and groundwater flows from higher elevations to a common body of water